Monetary policy, risk-taking channel and income structure: an empirical assessment of the French banking system

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June 2011

"L'université de Paris 1 Panthéon Sorbonne n'entend donner aucune approbation, ni désapprobation aux opinions émises dans ce mémoire ; elles doivent être considérées comme propres à leur auteur."

Acknowledgments

I am heartily thankful to Mrs. Jézabel Couppey-Soubeyran (Université Paris1, Panthéon-Sorbonne), Mr. Jérôme Coffinet (Banque de France) and Mr. Elie Kolakez (Phd, Université Paris2 Panthéon-Assas), whose encouragement, guidance and support enabled me to develop an understanding of the subject leading to its completion.

ABSTRACT

According to some recent empirical papers, periods of low interest rates would favor a risk-taking channel of monetary policy whereby bank risk-appetite and risk-taking behavior would be stronger after. Several theoretical explanations exist to this phenomenon, such as the managerial compensation schemes linked to fixed objectives, the procyclical valuation methods of assets, income and cash flows, or the abundant liquidity at a low cost. This paper studies the risk behavior of the main French banks during a recent period of low interest rates (1998-2008) and concludes to the existence of a risk-taking channel. In addition, our analysis suggests that liquid banks are more prone to risk-taking. We also highlight a higher risk transmission for banks relying more on fees and commission income.

Keywords: bank risk, risk-taking channel, monetary policy, income structure, liquidity, French banks.

Contents

I. Introduction

After the 2008 subprime crisis and the financial system disruptions that followed, many questions surfaced, rethinking the global financial system from every possible angle in search for loopholes to blame: the poor regulatory framework, systemic institutions, hazardous financial instruments, excessive reliance on rating agencies opinion, fuzzy accounting rules and standards, and bad bank governance. Last but not least, central banks are also indicted for putting on ultra loose monetary policies. This question is all the more striking as the present policy of the Federal Reserve in response to the crisis is also bringing back to memories the low interest rate levels applied in the aftermath of the technology bubble burst in 2001 and that some believe fanned the flame for the 2008 meltdown. This matter has turned to a vigorous debate among economists[1].

Recent studies show that "too low for too long" interest rates result in a higher risk-taking by banks through a "risk-taking channel". There exist many theoretical explanations, such as managerial compensation schemes and nominal objectives that lead to a higher risk taking when interest rates are low. Low interest rates boost asset value and collateral valuation leading to a money illusion and alter risk perception by banks. Risk can also derive from the presence of abundant liquidity or even from low credit screening standards when banks deal will a growing amount of credit requests. From 2009 onward, convincing empirical studies established that monetary policy is not fully neutral from a financial stability perspective. Evidence from the United States and Europe corroborated the reality of a risk-taking channel and showed that periods of very low interest rates are followed by higher risk-taking by banks.

These findings are of prominent interest to central banks with respect to the possible adverse effect of their policies on bank risk-taking. Also, supervisory and prudential authorities may find answers on when to be particularly vigilant, and on the subjects that could be more prone to risk-taking behavior.

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[1] See: (1) Rajan R., 2010, "Why we should exit ultra low rates: A guest post", *Freakonomics*, August 25. and (2) Krugman P., 2010, "Making it up", *The New York Times,* August 23.

In this paper, we follow methodology close to that of Altunbas et al. (2009), and assess the impact of low interest rates on French banks' risk during the 1998-2008 period. This paper brings novelty on different levels. First, our computation of risk-taking behavior is based on several accounting indicators, whereas other studies essentially rely on one measure in particular (Expected Default Frequency). Second, although other papers focus on US banks (in Altunbas et al (2009), American banks account for 70% of the sample individuals), we believe there is a strong case for studying French banks. Indeed, the risk-taking channel should be stronger in bank-based economies like France. On the other hand, the French system is highly regulated and has been adopting the universal banking model since the Second Banking Directive of the European Economic Community in 1989. Third, while the risk-taking channel has been studied relatively to individual banks characteristics such as size, capitalization and liquidity; our study is the first one to address the relation between risk-taking channel and bank income structure, bringing additional insights on the transmission mechanism.

Our results give evidence on the existence of a risk-taking channel of monetary policy for French banks, when assessed using seven different risk indicators. We also find an unorthodox positive link between GDP growth and higher risk levels. Our results also show a higher risk-taking transmission for liquid banks. Finally, risk-taking channel seems to differ according to income structure; results are in favor of basic banking models that are less prone to risk transmission of monetary policy.

The remainder of this paper is organized as follows: Section 2 presents a survey of theoretical and empirical work on the risk-taking channel. In section 3 we carry out our empirical assessment including robustness checks accounting for bank characteristics and income structure component. Section 4 concludes.

II. Monetary policy and risk-taking channel: from theory to empirical evidence

1. The credit channel

Before addressing the effect of short-term interest rates on risk appetite and risk-taking, one should first consider the impact of monetary policy on the real economy through credit. Classically, short-term interest rates determine the cost of capital and their level affect the investment decisions of firms. A large literature has investigated the monetary "black box" and illustrated its enhancement mechanism, referred to as the credit channel of monetary policy, through which levels of interest rates influence the demand and availability of credit (Bernanke and Blinder (1992), Mishkin (1996)). The credit channel has been broken down into a balance-sheet channel and a bank-lending channel (Bernanke and Gertler, 1995): In the balance-sheet channel, a drop in interest rates raises the value of assets (collateral) and cash flows[2] of candidate borrowers, both households and firms. This, in turn, reduces moral hazard and makes potential borrowers creditworthy, which leads to an increase in the supply of loans[3]. In the bank-lending channel, tight monetary policy like open market policies can drain deposits from the banks liabilities, forcing them to seek (uninsured) non-deposit financing at a higher cost (Kashyap and Stein, 1994). This alteration in the bank liability structure causes external finance premium[4] to rise and therefore a lower supply of intermediated credit. The bank-lending channel has the greatest effect on lending policies of the smallest and least liquid banks (Kashyap and Stein, 2000). To sum up, the credit channel can be seen as a dual effect of monetary policy on credit supply coming from both the asset and liability side of bank balance sheet.

The above literature discusses the nexus between monetary policy and loan supply, but does not address the risk appetite of banks. In fact when monetary policy is expansive, banks might engage in lending relations with borrowers that were perceived as risky in the past but are now eligible for credit due to an improvement in their net worth (following a drop in interest rates). However, there is a silver lining between granting more credit and higher-risk taking and the first does not necessarily imply the latter.

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[2] A decrease in interest rates reduces interest burden on borrowers. This eases the borrowers' cash flow since they rely on short-term debt to finance their working capital needs. Monetary easing also has a positive effect on aggregate demand and thus on firms' revenues.

[3] The balance-sheet channel can also operate directly on banks as lower interest rates can increase their assets valuation and therefore their capacity to attract funds.

[4] "External finance premium is the difference in cost between funds raised externally (by issuing equity or debt) and funds generated internally (by retaining earnings)" Bernanke and Gertler (2005).

2. Theoretical insights on the risk-taking channel

The designation of the "risk-taking channel" of monetary policy first appeared in Borio and Zhu (2008) who shed light explicitly on this transmission mechanism defined as "the impact of changes in policy rates on either risk perceptions or risk-tolerance and hence on the degree of risk in the portfolios, on the pricing of assets, and on the price and non-price terms of the extension of funding".

Practically, the channel can be explained by the effect of interest rates on valuations, income and cash flows. Low interest rates lead to a boost in collateral value, which alters risk perception and risk tolerance. Risk aversion also depends on banks' own net worth; lower interest rates imply a higher value of banks' assets portfolios, this leads to a higher net worth that entices banks to take more credit risk (Stiglitz and Greenwald, 2003). On the contrary, high levels of interest rates reduce banks' net worth triggering "gambling for resurrection" as a way out (Kane, 1989) (Hellman, Murdock and Stiglitz, 2000). One of the main reasons behind such risk myopia is the procyclical nature of risk indicators like the Value at Risk (Danielson et al, 2004) and the Probability of Default.

Another angle to explore the mechanism is through managerial compensation schemes that are linked to nominal targets, therefore giving managers incentives to take on more risk. In this context, low levels of short-term interest rates can lead to procyclical risk-taking by managers in an attempt to "search for yield" (Rajan, 2005). Such behavior is amplified by herding phenomena due to high competition between managers. It is also often related to the nature of the contracts as in the case of insurance companies and pension funds that often commit to long-term fixed performance targets.

Communication policies by monetary authorities can also lead to risk-taking (Borio and Zhu, 2008). When a central bank is predictable and transparent, as it is the case with most central banks, it removes the uncertainty about the future and creates an "insurance effect" leading to a general belief that it will dam up large downside risks.

Moreover, credit screening can be related to the presence of informational asymmetry among banks. Dell' Arriccia and Marquez (2006) show[5] that when dealing with a large volume of new borrowers, banks relax their screening standards and increase their risk-taking. The model also predicts that episodes of financial distress are more likely to take place after periods of strong credit expansion, corollary to periods of very low interest rates and/or financial deregulation.

Bank credit screening can also be distorted via habit formation; by analogy to the equity risk premium (Campbell and Cochrane, 1999), banks can become less risk-averse during periods of expansion and economic outputs that are higher than normal levels.

Risk-taking can also operate trough a "liquidity risk-taking channel". Diamond and Rajan (2006) show how banks can be exposed to a sudden rise in demand for money (after delays in aggregate production), this is followed by an increase in interest rates that banks should pay to depositors, thus increasing even more the deposit burden. In such cases, appropriate open market policies can ease the drought by lowering interest rate and limit the threat of deposit withdrawals, preventing credit rationing and bank failure. However, the stance of such policies and their duration is questioned (Diamond and Rajan, 2009); in a model with no uncertainty on the asset side of banks' balance sheet (loans quality), failure risk can come from massive withdrawals and liquidity shortage. When monetary policy is too expansionary, interest rates are low and banks are more levered-up playing on the mismatch between short-term deposits and long-term project financing. The more the bank is leveraged, the more the risk of failure, the model suggests that monetary policy should be tighter then the "normal level" (in expansionary periods) to reduce liquidity risk of banks.

The risk-taking channel is a relatively recent issue of monetary economics and finance, thus having its gray areas despite the advances that have been made. In fact, many unaddressed questions deserve closer exploration. Borio and zhu (2008) raise some issues for future studies: The financial sector is not yet captured in a general equilibrium model, let along the transmission channel of monetary policy that is in turn interdependent from funding liquidity and market liquidity. Accounting standards and fair value measures are

[5] See also Dell' Arricia et al (2011) on risk-taking in a model with leveraged financial intermediaries.

affected by interest rates, which influence behavior and financial decisions, adding to that the procyclical nature of risk indicator widely utilized by major financial actors globally. The risk-taking channel also raises the difficulty of coordination failure between financial institutions and finally the "insurance effect" of central banks policies.

Despite the fogginess of the transmission mechanism, more evidence is emerging from empirical studies that try to elucidate the modalities and characteristics of the risk-taking channel.

3. Empirical evidence on the risk-taking channel

Only a handful of studies test empirically the existence of a risk-taking channel. The first[6] is Jiménez et al (2009) who use data from the Spanish Credit Register. They study the evolution of Spanish credits from 1988 to 2006. This empirical assessment confirms the relation between the monetary policy stance and risk-taking by banks. The effect of interest rate differs depending on its lags. In the short-term, low interest rates reduce the interest burden on outstanding loans hence reducing the risk of default (the case of variable interest rates or refinancing). On the medium run, whilst granting new loans, banks showed to have softened their screening standards by granting credits to borrowers with bad credit history. The latter effect corroborates the hypothesis of "search for yield" backed by an illusion of wealth and collateral value gain. The study also shows that risk-taking is more manifest by small banks, for borrowers with multiple banking relations, and in a more competitive banking environment. It also appears that liquid banks take more risk, which can be attributed to a higher cost of holding liquid assets with low yields.

Ioannidou et al (2009) follow a similar methodology by studying individual loan data in Bolivia from 1999 to 2003, a period where the economy was almost fully dollarized. The US federal funds rate constitutes a good indicator of an exogenous monetary policy,

[6] Amato (2005) had already established a positive relation between CDS risk premiums and the real interest rate gap as a measure of monetary policy stance, studying the US CDS market during the period 2002-2005.

which was abnormally relaxed during the studied period. The study confirms that a decrease in interest rates prior to loan origination raises the probability of default on individual bank loans. It goes on to adding important insights on the pricing of the new risky loans. Surprisingly, Bolivian banks charged less the new risky loans relatively to the less risky ones, giving strong evidence of a change in risk perception (risk-premium). Results on bank characteristics showed that banks with low foreign funding take more risk, as they have no outside monitoring. Results are the same as Jiménez et al (2009) with respect to liquidity.

Altunbas et al (2009) study the risk-taking of 643 banks covering 16 countries[7] from 1998 to 2008. They estimate risk via the Expected Default Frequency[8] (EDF), a forward-looking indicator of risk. The study corroborates the relation between low interest rates[9] and bank risk. This conclusion remains valid when risk is assessed by idiosyncratic measures based on market information; risk-taking is established as specific to banks and is not a result of systemic components. Bank characteristics analysis shows a positive relation between size and risk-taking, liquid banks however are less risky. Those results differ from Jiménez et al (2009) and Ioannidou et al (2009) and can be linked to country specific or regulatory characteristics.

In addition, the degree of risk-taking is also a function of the time-span of the monetary easing period; Gambacorta (2009) shows that between 2002 and 2006 the US Federal Funds rate where below the benchmark[10] for 17 consecutive quarters versus 10 quarters for European banks, subsequently US banks where on average riskier than European banks.

Some other empirical researches study risk-taking with respect to lending standards. Dell' Arriccia et al (2009) assess the credit screening[11] in the US subprime mortgage market between 2001 and 2006, the results confirm their theoretical scheme (Dell' Arriccia and Marquez, 2006) whereby there is a negative correlation between the number of loan

[7] US banks constitute 71% of total sample individuals, which makes *de facto* their results US-focused.
[8] EDF is a risk indicator supplied by Moody's KMV.
[9] Interest rates are considered low relatively to the natural interest rate and the Taylor rule.
[10] Gambacorta applies the same methodology and database as Altunbas et al (2009).
[11] The study uses the Denial Rate and the Loan to Income ratios as lending standards indicators.

applicants and the quality of the screening, and this relation appears to be stronger when associated with more competition. Another important result is the negative relationship between screening quality and house price appreciation, which leads to think that American banks gambled on speculative borrowers. Similar results on the risk-taking channel come from Madaloni and Peydro (2010) who analyze lending standards[12] in the US and the Euro area from 2002 to 2008. They find that too low short-term interest rates soften lending standards, however the relation does not stand for long-term interest rates.

The most recent paper to our knowledge is of Delis and Kouretas (2011): the authors assess the risk-taking channel on 3,628 European banks from 16 countries over the period 2001-2008. They define bank risk using 2 indicators: the ratio of risky assets to total assets and the ratio of non-performing loans to total loans. Results confirm the existence of a risk-taking channel on the studied panel. More importantly, to authors notice a lower risk-taking for French banks[13]; results based on the "risky assets to total assets" indicator are les significant for France (significant at 10%), in addition, French banks show the highest average bank-lending rate in comparison to Germany, Italy and Spain.

III. Empirical assessment on the French banking system

1. The dataset and the indicators

Our dataset contains annual[14] balance sheet and income statement information extracted from Bankscope. The initial sample accounted for 150 banks operating in France; it has been narrowed down to 37 banks taking into account consolidation and subsidiaries accounts[15], along with data availability (descriptive statistics in Table 1). The French banking system is highly concentrated with 5 groups, operating under 9 banking entities that represent more than 90% of the industry total assets and total loans. Our sample covers those groups in addition to smaller banks. For macroeconomic data, interest rates

[12] They study answers from the Bank Lending Survey for the Euro zone and the Senior Loan Officer Survey for the US.
[13] The article studies 493 French banks, judging by the number of banks studied this means that subsidiaries (regional) accounts where favored over consolidated accounts.
[14] Unfortunately quarterly data was not available to us for this study, though it would have helped better capture the dynamic in the model.
[15] About 60 banks of the initial sample are regional subsidiaries of Groupe Crédit Agricole and Groupe Banque Populaire-Caisse d'Epargne and Groupe Crédit Mutuel.

where extracted from Reuters, GDP and inflation variables from the ECB and Eurostat, and housing prices from the INSEE.

- *Risk indicators*

Using the accounting data available we have constructed several risk indicators widely used in the literature as in Boyd and Graham (1986), Goyeau and Tarazi (1992), Lepetit et al. (2007), Altunbas et al (2010): (a) In the absence of reliable data on non performing loans for our sample we turned to the ratio of loan loss provisions to total loans, hereafter LLP, this ratio is considered to be a forward looking measure of expected credit losses as assessed and forecasted by banks. We also use the ratio of loan loss reserves to gross total assets (hereafter LLR) as a proxy for credit portfolio quality. (b) The Standard deviations of return on average assets, and return on average equity noted STDROA and STDROE measure return volatility. (c) The Z-score[16] of return on average assets, and equity (ZROA and ZROE, respectively) can be interpreted as measures of risk adjusted returns, and the ZP-score[17] (noted ZPSCR) is an indicator that captures portfolio risk and bank leverage risk; the latter three insolvency indicators imply lower risk the higher their values.

In addition to the above accounting-based indicators, we use the change in expected default frequency (ΔEDF), a forward-looking indicator computed by Moody's based on the Merton (1974) model of corporate bond pricing. EDF has been used in recent bank-risk literature as in Altunbas[18] et al (2009 and 2010) and Gambacorta (2009). Unfortunately, EDF data was only available for 14 French banks that we believe are worth studying as a separate sample (sample 1).

- *Evidence of low interest rate*

In Jiménez et al (2009), Ioannidou et al (2009) and Delis and Kouretas (2011) monetary policy stance is expressed by the change in overnight rates, the German interbank rates or the three months interbank. Their assumption is that interest rates where below their

[16] ZROE = (100 + average ROE%) / STDROE% (Boyd and Graham, 1986).

[17] ZP-score = $\frac{average\,ROA}{STDROA} + \frac{average(Total\ equity / Total\ assets)}{STDROA}$, Goyeau and Tarazi (1992).

[18] We thank M. Yener Altunbas (Bangor University), for giving us access to the French banks EDF data.

historical levels. On the other hand, Altunbas et al (2009) analyze monetary stance with respect to what the Taylor rule dictates. We follow the latter strategy that answers the question "how low is low?" with a specific benchmark since we are analyzing the impact of excessively low rates and not a drop in interest rates, moreover results in Altunbas et al (2009) show a different effects (signs) for the three months rate and the Taylor gap on risk-taking.

Taylor rule gap (TGAP) is defined as the difference between the 3 months French interbank rate and the rate implied by the Taylor rule with interest rate smoothing, according to the formula: $i_t = \alpha + \beta_\pi(\pi_t - \pi^*) + \beta_y(y_t - y^*) + \gamma(i_t - i_{t-1})$.

TGAP is computed using β_π=1.5 and β_y=0.5 giving more weight to the inflation objective and using an interest rate smoothing coefficient (α) of 0.9. The target inflation (π^*) has been set to 2% in reference to the ECB objectives, and the real interest rate (α) has been set to 4% assuming a nominal long-term interest rate of 2%. Chart1[19] shows evidence of a lean monetary policy during the period 2000-2008, with a maximum gap of 2.6% in 2004. We use the change in the 3 months interbank rate (Δ3M) as a measure of monetary policy stance, and the slope of the yield curve[20] (YSLOPE) as an indicator of money market conditions that influence the "transformation" activity of banks and their profitability.

2. The empirical strategy

We use the Arellano and Bover (1995) and Bundell and Bond (1998) Dynamic GMM panel to cope with the following typical obstacles: (a) In order to analyze the dynamic and persistence of risk-taking with respect to change in monetary policy, the risk variables will be regressed over their lags, which produces simultaneity among the independent variables. (b) Time-invariant bank characteristics, which are present in the

[19] Alternatively, we compute TGAP1 following the standard Taylor rule, with $\beta_y = \beta_\pi$= 0.5 and γ=0. The two measures are strongly correlated (R2 = 0.6), hence we base our analysis on the TGAP with interest rate smoothing that is less severe in average that TGAP1.

[20] YSLOPE is equal to the 10 years French government bond minus the 3 months interbank rate

error term, may be correlated with the explanatory variable. System GMM removes the fixed effect from the error term. (c) We are in the case of a “small T - large N” sample, meaning that bank specific shocks will persist over the short time-spam studied. Also, any correlation between the lagged dependent variable and the error term will be persistent in small time series. (d) The explanatory variables in our model are not strictly exogenous, thus they will be instrumented using their lagged levels.

Following recommendations by Roodman (2006) on dynamic panel modeling in Stata, we use forward orthogonal deviation (Arellano and Bover, 1995) to minimize data loss. We also add in the regression of sample1 time dummies[21] (as 9 out of the 14 banks studied are related to one group and thus strongly correlated). We test our model using the Sargan test for over-identifying restrictions that ensures the validity of the instruments when its related P-value is large. Also, we validate the AR1 and AR2 tests for first and second-order autocorrelation; AR1 P-value is expected to be low, implying a first order correlation (expected in the difference GMM equation), AR2 P-value should be large accepting the null hypothesis of no order 2 serial correlations of the residual term.

Bank specific variables are tested for stationnarity with the Levin-Lin-Chu test. Results in Table 5 confirm stationnarity except for STDROE.

3. Assessment based on Expected Default Frequency (sample 1)

Our first sample is constituted of a panel of 14 banks with data covering the period 1998-2008. We start with the following model in which we regress the annual change in Expected Default Frequency (ΔEDF) on its one-year lag, change in the three months interbank rate (Δ3M), the Taylor rule gap (TGAP), the change in nominal GDP

[21] *“Include time dummies: The autocorrelation test and the robust estimates of the coefficient standard errors assume no correlation across individuals in the idiosyncratic disturbances. Time dummies make this assumption more likely to hold.”* Roodman (2006) p.43

(ΔGDPN[22]). We also add yearly dummies in our specification to end up with the baseline model (I):

$$\Delta EDF_t = \alpha\,\Delta EDF_{t-1} + \beta\Delta 3M_{t-1} + \gamma\,TGAP_{t-1} + \lambda\,\Delta GDPN_{t-1} + \sigma\,Dum + \varepsilon$$

Results in table 6 confirm the dynamic aspect of our risk equation, with a positive and significant coefficient (0.316) for the lagged dependent variable; this coefficient can be interpreted as the speed of convergence to the optimal risk level, with values closer to zero meaning a higher speed of adjustment. The monetary policy stance measured by Δ3M has the positive expected sign; lower rates reduce the interest burden on outstanding loans leading to less risk on credit portfolios, such effect has been established in Jimenez et al (2009) as a short-term effect of low interest rates.

The coefficient of the TGAP is negative and significant confirming that when interest rates are below the Taylor benchmark (smaller/negative values of TGAP), banks take more risk. Our results are so far consistent with the discussed literature.

Coming to our first macroeconomic variable, the coefficient of ΔGDPN is positive and significant; in times of good economic outlook banks tend to grant more credit thus reducing their screening process (Dell' Arriccia et al, 2009), banks can also engage in riskier activities in search for high yield. Delis and Kouretas (2011) find a similar nexus between GDP growth and risk when analyzing the European banking sector; in fact, risk can be higher despite good economic conditions.

We extend out model by adding the annual changes in the stock market returns (ΔSM) and the changes in the housing price index (ΔHP) leading to results II and III respectively in table 6:

$$\Delta EDF_t = \alpha\,\Delta EDF_{t-1} + \beta\Delta 3M_{t-1} + \gamma\,TGAP_{t-1} + \lambda\,\Delta GDPN_{t-1} + \varphi\Delta SM_{t-1} + \theta\,\Delta HP_{t-1} + \sigma\,Dum + \varepsilon$$

Whereas we expect for the stock market returns a similar result as for GDP growth, we find a negative coefficient for the change for stock market returns (ΔSM), suggesting that a rise in stock returns reduces bank risk. A possible interpretation is that higher stock

[22] ΔGDPN has been orthogonalized with respect to Δ3M due to high correlation (0.8) between those variables.

market returns are associated with a higher value for securities portfolios held by banks as well as an upward valuation of collateral.

We analyze housing prices as one of the main drivers behind the 2008 crisis; we do not establish a significance of the coefficient for the change in housing prices (ΔHP). In fact, France did not experience a housing boom-bust cycle, and the reason behind that could be the strong regulation[23] of housing related credit activities.

In equation IV, we account for market concentration as a proxy for the level of competition in the banking sector. We add to the equation a Herfindahl-Hirschman index (HHI) calculated based on individual loans share of total sample loans:

$$\Delta EDF_t = \alpha\,\Delta EDF_{t-1} + \beta\Delta 3M_{t-1} + \gamma\,TGAP_{t-1} + \lambda\,\Delta GDPN_{t-1} + \varphi\Delta SM_{t-1} + \theta\,\Delta HP_{t-1} + \eta HHI + \sigma\,Dum + \varepsilon$$

As smaller values of HHI imply more competition, the negative sign of this variable corroborates the "search for high yield" hypothesis (Rajan, 2005) and brings evidence that bank risk is higher in more competitive markets.

We finally conclude this section by accounting for the yield curve slope (YSLOPE). This measure was dissociated from the other interest rate components due to strong correlation with Δ3m and TGAP. We regress the following equation V of table 6:

$$\Delta EDF_t = \alpha\,\Delta EDF_{t-1} + \gamma\,TGAP_{t-1} + \delta YSLOPE_{t-1} + \lambda\,\Delta GDPN_{t-1} + \sigma\,Dum + \varepsilon$$

Results are similar to those obtained in the previous specifications. Including the yield curve in our equation helps analyzing the core business of banks. The variable YSLOPE has a negative and significant coefficient; in fact, when the yield curve is steep the transformation activity of banks is more profitable considering the duration mismatch between the long-term assets and the short-term liabilities, which explains the lower bank risk. Results remain unchanged in term of signs and significance when we orthogonalize YSLOPE to TGAP to cope with high correlation (not reported).

[23] The Neiertz law (1990) on property loans aims to avoid over-borrowing, it caps periodical credit installment to 33% of the net revenue in that period and is rigorously applied by banks.

4. Regression results for different measures of risk (sample 2)

In this section, we assess a large panel of 37 banks during the period 1998-2008. We use several accounting based indicators (as detailed in section III, Paragraph 1) in an attempt to confirm the results established so far. The best fitted model in terms of coefficient significance is a regression of each risk indicator on its one-year and two-years lags, the change in the three months interbank rate (Δ3M), the Taylor rule gap (TGAP), the change in nominal GDP (ΔGDPN) and the change is stock market returns (ΔSM)[24]:

$$Risk\,Measure_t = C + \alpha\,Risk\,Measure_{t-1} + \beta\sum_{j=1}^{2}\Delta 3M_{t-j} + \gamma\sum_{j=1}^{2}\Delta TGAP_{t-j} + \lambda\sum_{j=1}^{2}\Delta GDPN_{t-j} + \varphi\sum_{j=1}^{2}\Delta SM_{t-j} + \varepsilon$$

Table 7 summarizes the results of our dynamic panel model for seven risk measures. We first find that the LLP measure for credit portfolio quality does not fit in any model involving our variables. This can be related to the annual frequency of our data or to the fact that provision amounts are discretionary and are often used by banks as a mean to smooth income (Fonseca and Gonzalez, 2008).

The results from the remaining variables (columns II to VII) corroborate our previous finding on the risk-taking channel; we find a positive relation between low interest rates (the gap to the Taylor rule) and risk. In fact, we find a negative and significant coefficient for the TGAP coefficients in the LLR, STDROE and STDROA regressions, and a positive and significant coefficient of TGAP in the ZROE, ZROA and ZPSCR regressions[25]; a deeper gap between the three months interbank rate and the rate implied by the Taylor rule is associated with a higher risk after two years of time giving more evidence on the "too low for too long" theory on interest rates and bank risk.

Also, results for the monetary policy stance seem to hold in four out of six models; the coefficients of Δ3M are positive and significant at 10% in models II and III, and positive

[24] The variables ΔGDPN and ΔSM have been orthogonalized respectively with Δ3M and TGAP due to high correlation of 0.8 for ΔGDPN with Δ3M, and 0.59 for ΔSM with TGAP. The correlation with the modified variables dropped to zero.
[25] We remind that the latter three variables represent higher risk, the lower their values.

and significant at 1% in models VI and VII. On the short-term, the effect of a drop in interest rates reduces risk through interest burden cutback on outstanding loans, or through positive asset valuation.

Models III, VI and VII (which show significant GDP effect) bring similar results as the EDF model showing a positive relation between GDP growth and bank risk. As we previously mentioned bank risk can take place in spite of good economic conditions (Delis and Kouretas, 2011) and the case of the French banking system seems to fall in that scheme. This result is atypical when compared to the literature where higher economic growth reduces bank risk.

Last, the stock market returns have a significant effect on risk in models II, III, VI and VII; the change in stock market returns has a positive relation with the risk indicators. In periods of low interest rates, asset valuation is boosted which increases risk due to an illusion of higher collateral value and/or a balance sheet effect (Stiglitz and Greenwald, 2003). Note in this section that results differ from the one obtained in the EDF regression as they follow the GDP growth pattern and back the idea that risk taking channel for French banks can occur despite economic and market growth.

5. Risk-taking channel and bank characteristics

In this section we estimate further regressions analyzing the effect of the TGAP variable with respect to individual characteristics, including bank size (SIZE), capitalization (CAP) and liquidity (LIQ)[26]. Whereas liquidity is addressed in the risk-taking literature (Jimenez et al. (2009), Altunbas et al. (2009), Ioannidou et al. (2009)) by the ratio of liquid assets to total assets, we define liquidity as the ratio of liquid assets to deposits and short-term funding. Our definition can be interpreted as a pseudo-LCR[27], which replicates better the regulator's liquidity requirements.

[26] SIZE = log of total assets; CAP = total equity / total assets; LIQ = liquid assets / deposits and short-term funding.

[27] Leverage Coverage Ratio= (High Quality Assets)/(30 Day Net cash Outflows) ≥ 100%, as by the Basel III committee definition.

We differentiate each of the above variables into three classes according to its percentile distribution; we label as "small" the variables below the 25% percentile region, as "average" the variables within the 25%-75% percentile, and as "large" the variables above the 75% percentile. We then add dummy variables "I" for each of the three classes, which we multiply with the significant TGAP in our regressions; the result is a dissecting of the TGAP effect within the three classes. The advantage with this approach is that it offers a dual filtering of the bank characteristic classes, first by level of significance and then by coefficient value. The model can be written as follows:

$$Risk\ Measure_t = C + \alpha\, Risk\ Measure_{t-1} + \beta \sum_{j=1}^{2} \Delta 3M_{t-j} + \gamma \sum_{j=1}^{2} \Delta TGAP_{t-j} * I_{class\ i} + \lambda \sum_{j=1}^{2} \Delta GDPN_{t-j}$$

$$+ \varphi \sum_{j=1}^{2} \Delta SM_{t-j} + \varepsilon$$

Results for size, capitalization and liquidity interaction with the Taylor rule gap variable are respectively reported in Tables 8, 9 and 10 for the six valid accounting based risk models (models II to VII).

In Table 8, we conclude that the risk channel is more important for large French banks; notice a significance level of 1% for the "large SIZE" interaction with TGAP for all risk indicators except LLR (model II). Furthermore, for a same level of significance as is the case with the ZROA variable, "large SIZE" banks have a higher TGAP coefficient of 20.9 versus 15.1 for "small SIZE" banks, thus delivering a stronger effect on bank risk level. Large bank can in fact engage in more risky activities because of higher competition or moral hazard. Similar results of "too big to fail" behavior where found in Altunbas et al (2009).

Results for bank capitalization (Table 9) show that banks with lower equity to assets ratio have a higher risk-taking, backed by a significance level at 1% in regressions III, V, VI and VII. In regression VI, TGAP coefficient is 21.2 for small capitalization versus 18.7 and 14.7 for average and large capitalizations respectively. We note that small capitalization level in our sample fall below 3.7% of equity to total assets, which is a relatively low level compared to sample mean of 6.11%.

After the recent crisis, regulators have noticed a pitfall in bank liquidity, in fact whereas banks where in line with capital requirements, their liquidity did not appear strong enough to withstand liquidity drought scenarios in interbank markets. In reaction to that, new liquidity ratios where defined by the Basel III committee (Basel Committee on Banking Supervision, 2010): the Liquidity Coverage Ratio and the Net Stable Funding Ratio[28] that are supposed to increase bank holding of “high quality assets” to avoid chocks or bank runs. Considering those recent developments on bank liquidity, we analyze the interest rate channel in respect to the liquidity ratio previously defined.

We find in all six regressions (Table 10) that (more) liquid banks have a higher transmission mechanism (higher and more significant TGAP coefficient). This does not however mean that illiquid banks are less risky than liquid bank, but rather that a change in monetary policy in a too low for too long direction will have, all other things being equal and with the assumption of no change in bank behaviour, a higher effect on the level of risk of liquid banks. In the risk taking literature, the same effect for liquidity is found for the Spanish banking system (Jiménez et al, 2009) and for Bolivia (Ioannidou et al, 2009). When yields on “high quality assets” are low, liquid banks have a higher cost in carrying such assets, this can change their investment strategy towards more risky assets and/or their credit strategy towards riskier projects with longer maturity. Our findings raise a question on whether the new liquidity requirements will render banks more vulnerable to risk-taking, especially since maturity mismatch cannot be eliminated (without eliminating the transformation activity of banks).

6. Risk-taking channel and income structure

We now analyze risk-taking channel in relation with bank income structure. We try to explore if monetary policy, affects bank risk differently with respect to their product mix.

[28] LCR= (High Quality Assets)/(30 Day Net cash Outflows) ≥ 100%
NSFR= (Available Stable Funding)/(Required Stable Funding) ≥ 100%

- A brief literature on revenue diversification

The literature on bank risk and revenue diversification is somewhat divided. Interestingly, results seem to differ according to their timing, mainly as a result of changes in the financial intermediation business model. Studies on the US banking industry in the seventies and the eighties give evidence on limited diversification benefits (Boyd et al, 1980) (Kwast, 1989). More recent studies show that that fee-based activities increased the volatility of bank revenue, as in DeYoung and Roland (2001) who analyze US commercial banks from 1988 to 1995. Stiroh (2004) analyses US commercial banks from 1988 to 1995 to find that net interest income and non-interest income are increasingly correlated leading to lower diversification benefits. Another study from Stiroh (2006) over the period 1997-2004 shows no significant link between non-interest income exposure and average returns.

Turning to the European market and with more recent data on 734 banks from 1996 to 2002, Lepetit et al (2007) study risk in relation to income structure. They find that higher reliance on non-interest activities is associated with more risk, but the relation is mainly associated with commission and fees generating activities rather than trading activities. More recently, De Jonghe (2010), studies the relation between income structure and systemic risk (measured by tail beta) on European banks during the 1992-2007 period, results show that a shift to non-interest generating activities increases bank systemic risk. The above results are in favor of basic banking, intuitively this can be explained (DeYoung and Roland, 2001) by factors such as the poor regulation on the non-interest activities, the important fixed costs associated with fee-based activities that are not yet amortized, or finally the high competition on fee and commission based markets.

Our interest in income structure slightly differs from the above literature, as we seek to understand more on the risk-taking channel of monetary policy. The question is whether the risk-taking mechanism is stronger in traditional banking and therefore could be linked to credit risk and loose screening standards, or if the transmission is rather related to fee-based activities and is therefore subject to asset valuation and market risk. We have to acknowledge however that both activities are interdependent; in the case of a bubble burst, both trading portfolios and credit portfolios are affected, as price drop will hit both investment portfolios and credit collateral.

- Indicators, methodology and results

We account for income structure using two indicators used in the above mentioned literature to set the line between traditional banking versus market and consulting-based activities: The loans-to-assets ratio (LTA), and the net interest income (NII) defined as the ratio of net interest income to net operating income (Stiroh, 2004). We use the same strategy as in section III paragraph 5, by dividing each income structure indicator in three classes following the same percentile distribution we used previously.

$$Risk\,Measure_t = C + \alpha\, Risk\,Measure_{t-1} + \beta \sum_{j=1}^{2} \Delta 3M_{t-j} + \gamma \sum_{j=1}^{2} \Delta TGAP_{t-j} * I_{class\,i} + \lambda \sum_{j=1}^{2} \Delta GDPN_{t-j}$$
$$+ \varphi \sum_{j=1}^{2} \Delta SM_{t-j} + \varepsilon$$

We first analyze the loans to assets ratio and report results in Table 11. We find dual results; when risk is approximated by loan loss reserves (model II), the TGAP effect on risk level is higher for traditional banking (larger loans to assets ratios), which can mean that the transmission mechanism of low interest rates happens through credit risk-taking. We do not however jump to that conclusion since the effect itself is only significant at 10%. Moreover, the results in models III to VII show an opposite and more significant relation with risk transmission being higher for banks with smaller LTA ratios. In fact, banks with LTA ratios larger than 75% (see Table 2 for descriptive statistics) do not show any risk-taking behavior following low interest rates. In contrast, banks with LTA ratios lower than 30% have the more significant TGAP effects in our regressions.

Our second analysis on net interest income is reported in Table 12. We notice that the significance of the TGAP effect is well spread over the three defined NII classes, this means that the TGAP risk transmission reaches all banks disregarding their income structure. The magnitude of this effect however differs; it is stronger on banks with medium and small NII ratios (ratios less than 77%). Commission and fee-based activities are more predisposed to risk-taking; reasons behind this are, as described by DeYoung and Roland (2001), the poor regulation of such activities and moral hazard, the important structures put in place for this relatively new business line and that are not yet amortized, and high competition in that segment (Rajan, 2005).

The overall results from both income structure measures seem to advocate basic banking activities as a banking model whose risk is less affected by low interest rates.

IV. Conclusion

Following the 2008 financial crisis, researchers and policymakers assessment ended with a long list of economical explanations that included the poor regulatory framework, systemic institutions, complex financial instruments, rating agencies misleading opinions, blurry accounting measures, and bad corporate governance. Surprisingly, ultra expansionary monetary policy was found to be one possible cause to add in after recent empirical studies gave evidence of a risk-taking channel of monetary policy: Bank risk-appetite and risk-taking is higher after periods of very low interest rates.

In fact, risk-taking can be explained by (a) a “search for high yield” in the presence of managerial compensation schemes linked to fixed objectives, (b) the procyclical valuation methods of assets, income and cash flows that change risk perception and credit decisions, (c) the abundant liquidity at a low cost available on demand for financial institutions, and (d) an insurance effect of central banks whose policies are perceived as guarantors of assets value.

Moreover, we believe the topic of the paper is of current interest. The Federal Reserve expansionary monetary policy in response to the 2008 crisis is being accused of building-up asset bubbles, in the same scheme that took place after the dotcom bubble. A situation better described in the saying “fool me once shame on you, fool me twice shame on me”.

Using a dynamic panel model, we have studied the risk of French banks from 1998 to 2008, a period of very low interest rates. We concluded to the existence of a risk-taking channel; low interest rates (measured by the gap between the three months interbank rate and the rate dictated by the Taylor rule) leads to a higher level of bank risk. We also find that liquid banks are more likely to amplify this channel, thus raising a question on whether the new Basel III liquidity requirements will render banks more prone to risk-taking following low interest rates periods.

Another interesting result is the positive relation found between GDP growth and bank risk, meaning that risk-taking can occur in good times. We finally capture the risk-taking channel with respect to bank income structure; results are in favor of universal banking models since the risk transmission is higher for commission and fee-based banks. In that, we hope to have added some insights that can be useful for supervisory and prudential authorities.

This work is somewhat limited by the availability of the data as we would have preferred to work on quarterly data that convey more information, especially when using accounting based indicators. On the other hand, using in our case a higher frequency or even market data would have limited our sample to a handful of banks. Another limitation is the high correlation found between macroeconomic variables, that we managed to reduce with variables orthogonalization.

Finally, the present topic can be subject to several enhancement and extensions for future research. It will be of interest to make similar studies on a larger multi-country scale using extreme risk indicators to see how the channel acts with respect to systemic risk. The channel can also be studied in relation with the credit contract structure in an attempt to differentiate the risk-taking effect on fixed interest rates regimes versus variable interest rates. The income structure approach we followed can be developed on a larger sample adding variables for commissions and trading activities. Accounting for securitization can also bring interesting results; the “originate and distribute” model might have an effect on risk-taking behavior, since banks anticipate bad assets transfer through a “true sale” mechanism. We also think of insurance companies as major actors on the financial intermediation scene; monetary policy effect should also be studied on “monolines” as their activity is closely linked to credit, and their risk is a potential threat to the banking system.

Tables and Charts

Table 1
Desriptive statistics of sample (year end 2008)

(Amounts in millions of Euros)	Mean	Median	Min	Max	**Total sample**
Sample 1: Analysis based on accounting risk mesures (37 banks)					
Assets	253,692	23,067	674	2,075,551	**9,386,589**
Equity	14,634	1,079	-1,910	58,966	**278,050**
Loans	78,619	15,670	209	494,401	**2,908,895**
Income	2,976	470	-112	26,632	**110,111**
Sample 2: Analysis based on Expected Default Frequency (14 banks)					
Assets	387,609	12,648	3,011	2,057,698	**5,426,530**
Equity	12,169	1,288	169	58,459	**170,365**
Loans	123,291	10,441	1,911	678,766	**1,726,075**
Income	2,922	215	66	14,136	**40,902**

Source: Bankscope

Table 2
Summary statistics of the variables (1998-2008)

Variables	Number of observations	Mean	Median	Std. Dev	Min	Max	Q1	Q3
Variables accounting for Bank Risk								
LLP	388	0.66	0.42	2.58	-2.53	47.03	0.15	0.67
LLR	363	4.44	3.71	3.10	0.00	14.36	2.17	6.10
STDROA	389	27.56	11.53	54.39	0.29	601.93	6.38	27.31
STDROE	389	4.45	2.19	9.76	0.01	111.87	1.08	4.90
ZROA	391	21.80	13.71	36.83	-0.69	446.75	5.80	25.17
ZROE	389	78.82	50.19	91.21	0.12	800.51	22.84	96.74
ZPSCR	391	8.57	4.96	17.31	-2.68	264.30	2.33	9.49
ΔEDF	128	0.00	-0.01	0.16	-0.53	0.60	-0.05	0.03
EDF	142	0.17	0.10	0.20	0.02	1.19	0.06	0.20
Variables accounting for Monetary Policy								
TGAP1	11	-0.72	-0.98	1.18	-2.58	1.50	-1.81	0.47
TGAP	11	-0.29	-0.55	1.84	-2.63	3.79	-1.85	0.00
Δ3M	11	0.09	0.03	0.80	-1.03	1.55	-0.54	0.97
YSLOPE	11	1.02	0.93	0.70	-0.29	1.92	0.72	1.83
Variables accounting for Bank Caracteristics								
LTA	388	52.87	53.27	26.66	1.46	98.08	30.22	75.03
NII	391	55.07	53.08	29.21	-64.36	152.38	37.56	77.14
SIZE	391	16.80	16.63	2.34	12.53	21.45	14.79	19.05
CAP	391	6.11	5.39	3.06	1.08	16.58	3.67	8.09
LIQ	391	41.43	33.47	34.39	0.23	177.43	13.98	59.59
Macroeconomic variables								
ΔGDPN	11	3.98	3.93	0.73	2.77	5.23	3.37	4.55
ΔHP	11	8.51	7.90	9.48	-14.63	22.33	2.50	13.50
ΔSM	11	-5.68	-1.17	21.94	-52.59	33.64	-9.39	2.55
HHI	11	9.42	9.41	0.22	9.15	9.81	9.17	9.67

Variables definition: LLP = loan loss provision/total loans; LLR=loan loss reserves/total gross loans; STDROA (ROE) = standard deviation of return on average assets (equity); ZROA (ROE) =(100+average ROA)/std dev ROA) is the Z-score of return on average assets (equity); ZPSCR = ZP score computed as: [(average ROA / STDOA)+(average(total equity/total asset) / STDROA)]; EDF = expected default frequency one year ahead; TGAP(1) = Taylor rule gap; Δ3M = change in the 3 months interbank rate; YSLOPE = slope of the yield curve (10Y-3M); LTA = total loans / total assets; NII = net interest income / total operating income; SIZE = log of total assets (th of Euros); CAP = total equity / total assets; LIQ = liquid assets / deposits and short-term funding; ΔGDPN = change in nominal GDP; ΔHP = change in the housing price index; ΔSM = changes in the stock market returns; HHI = Herfindahl-Hirschman index.

Table 3.a
Correlation matrix for sample 1

	EDF	ΔEDF	TGAP1	TGAP	T3M	Δ3M	Δ10Y	YSLOPE	LTA	NII	SIZE	CAP	LIQ	ΔGDPN	ΔHP	ΔSM	HHI
EDF	1																
ΔEDF	0.2938*	1															
TGAP1	0.2208*	-0.0679	1														
TGAP	0.3500*	0.4437*	0.5446*	1													
T3M	0.1405	0.1948*	0.5468*	0.6701*	1												
Δ3M	-0.1191	-0.0631	0.2445*	0.1899*	0.5351*	1											
Δ10Y	-0.1554	-0.1099	0.1488	-0.0818	0.3616*	0.5827*	1										
YSLOPE	-0.0204	-0.3267*	-0.2971*	-0.6632*	-0.7903*	-0.6110*	-0.2103*	1									
LTA	0.1245	-0.001	0.0061	0.033	0.0365	0.0231	0.0177	-0.0441	1								
NII	0.0452	0.092	-0.0549	0.093	-0.0925	-0.1585	-0.1575	0.0328	0.5357*	1							
SIZE	-0.1730*	0.046	0.0016	0.0375	0.0372	0.0432	0.022	-0.0701	-0.8931*	-0.6400*	1						
CAP	-0.0647	-0.0376	-0.141	-0.1429	-0.0714	0.0617	0.0737	-0.0425	0.8166*	0.4453*	-0.7444*	1					
LIQ	-0.1664	0.0147	0.0048	0.0332	0.0322	0.1187	0.0684	-0.1472	-0.8592*	-0.3540*	0.8018*	-0.6959*	1				
ΔGDPN	-0.1073	-0.3597*	0.4499*	-0.048	0.2953*	0.8012*	0.4888*	-0.1596*	-0.0072	-0.1917*	0.0019	0.012	0.0359	1			
ΔHP	-0.0041	-0.0105	-0.0249	-0.0161	-0.005	0.0229	0.0176	-0.0208	0.0372	0.1437	-0.0451	0.0063	0.0593	0.0049	1		
ΔSM	-0.1403	-0.2321*	-0.3292*	-0.5868*	-0.6607*	0.0267	0.0287	0.5939*	-0.0154	0.0099	-0.0337	0.0323	-0.0379	0.2440*	0.004	1	
HHI	-0.1245	-0.0516	-0.1226	-0.0764	-0.0002	-0.2020*	-0.0575	0.0475	-0.0196	-0.0183	-0.0052	0.0848	-0.0209	-0.0358	0.0066	-0.1649*	1

Table 3.b
Correlation matrix for sample 2

	LLR	LLP	STDROA	STDROE	ZROA	ZROE	ZPSCR	TGAP1	TGAP	ΔЗM	YSLOPE	LTA	NII	SIZE	CAP	LIQ	ΔGDPN	ΔHP	ΔSM	HHI
LLR	1																			
LLP	0.2701*	1																		
STDROA	0.0603	0.2058*	1																	
STDROE	-0.0425	0.0655	0.2297*	1																
ZROA	0.0348	-0.0374	-0.2042*	-0.1662*	1															
ZROE	0.0282	-0.05	-0.2425*	-0.2736*	0.4469*	1														
ZPSCR	0.0815	-0.0194	-0.1614*	-0.1485*	0.8999*	0.3832*	1													
TGAP1	0.0413	-0.0187	-0.0944	0.0783	-0.0962	-0.0473	-0.1235*	1												
TGAP	-0.0664	-0.0141	-0.0295	0.1117*	-0.092	-0.0292	-0.1115*	0.5446*	1											
Δ3M	-0.1664*	-0.0015	0.0624	0.0694	-0.035	-0.0235	-0.0221	0.2445*	0.1899*	1										
YSLOPE	0.2509*	0.0122	-0.0693	-0.1590*	0.1008*	0.0642	0.0872	-0.2971*	-0.6632*	-0.6110*	1									
LTA	-0.0322	-0.0604	0.0436	-0.0651	0.042	0.0663	0.1087*	0.0139	0.0163	-0.0071	-0.0063	1								
NII	-0.0518	0.0072	0.0527	0.0022	0.1079*	0.1972*	0.1169*	-0.0004	0.0691	-0.0288	-0.0217	0.5445*	1							
SIZE	-0.2003*	-0.0991	-0.2387*	0.0861	0.0546	-0.0146	-0.0677	0.01	0.0343	0.0356	-0.0586	-0.4002*	-0.3478*	1						
CAP	0.1433*	0.1381*	0.4073*	-0.1060*	-0.0653	0.0688	0.074	-0.1405*	-0.0887	0.0158	-0.0261	0.1494*	0.3102*	-0.6680*	1					
LIQ	-0.0871	0.0215	0.0294	0.0661	-0.0325	-0.1000*	-0.0832	-0.0266	0.0235	0.1131*	-0.1291*	-0.7560*	-0.4379*	0.3719*	-0.1629*	1				
ΔGDPN	0.0003	0.0026	-0.0077	0.0001	0.0264	0.002	0.0156	0.4499*	-0.048	0.8012*	-0.1596*	-0.0051	-0.049	-0.0007	-0.0466	0.0276	1			
ΔHP	-0.1136*	0.0161	0.1427*	-0.0429	0.0725	-0.0275	0.1291*	-0.6670*	-0.7515*	0.1463*	0.2646*	-0.0231	-0.0529	0.0013	0.1545*	0.0974	0.1296*	1		
ΔSM	0.0896	0.0021	0.037	-0.0592	0.0117	0.0019	0.0438	-0.3292*	-0.5868*	0.0267	0.5939*	-0.0129	-0.0108	-0.0257	0.0674	-0.0099	0.2440*	0.5122*	1	
HHI	0.0281	-0.0351	0.0199	-0.0191	0.1049*	-0.0314	0.0815	-0.1226*	-0.0764	-0.2020*	0.0475	0.0124	-0.0097	-0.0194	0.0295	-0.0246	-0.0358	0.1194*	-0.1649*	1

Table 4
Expected signs/effects of explanatory variables

Variables	Expected sign/relation	Interpretation
Dependent variables		
EDF, LLP, LLR, STDROA, STDROE, ZROA°, ZROE,° ZPSCR°		
Explanatory variables		
TGAP	-	RTC, a lower gap scalar (higher gap) is associated with higher risk-taking
Δ3M	+	Lower interest rates derease bank risk on the short run (outstanding loans)
YSLOPE	+/-	+ steep curves means higher missmatch opportunities, leading to higher risk-taking - steeper curves could also increase profitability and hense reduce banks' risk
ΔGDPN	+/-	- Better economic conditions increase projects' success and reduce bank risk + Favorable economic conditions induce higer risk-taking in search for high yield
ΔSM	+/-	+ In the case of a bubble burst risk should be higher (2008-2009 effect) - otherwise, higher stock performance reduce credit risk and banks' risk
ΔHP	-	Higher housing prices increase collateral value and reduce credit risk
HHI	-	Higher competition increase bank risk
SIZE	+/-	+ large banks where mostly affected during the crisis / competition / moral hazard - Small banks are more vulnerable and gamble for survival
CAP	-	Well capitalized banks are less risky
LIQ	+	More liquidity mean a higher cost when rates are low, wich enduces a more aggressive placements and hazardous long term financing
LTA	-	Fee and commission based activities increase bank risk: poor regulation of non-interest activities, important fixed costs not yet amortized, or high competition on fee and commission markets (DeYoung and Roland, 2001)
NII	-	

° *for* ZROA, ZROE, ZPSCR, *expected signs and interpretation arr inverse as higher values mean lower risk*

Variables definition: EDF = expected default frequency; LLP = loan loss provision/total gross loans; LLR=loan loss reserves/total gross loans; STDROA (ROE) = standard deviation of return on average assets (equity); ZROA (ROE) = Z-score of return on average assets (equity); ZPSCR = ZP score computed as: [(average ROA / STDOA)+(average(total equity/total asset) / STDROA)]; Δ3M = change in the 3 months interbank rate; TGAP = Taylor rule gap; YSLOPE = slope of the yield curve (10Y-3M); ΔGDPN = change in nominal GDP; ΔSM = changes in the stock market return; ΔHP = change in the housing price index; HHI = Herfindahl-Hirschman index; SIZE = log of total assets (th of Euros); CAP = total equity / total assets; LIQ = liquid assets / deposits and short-term funding; LTA = total loans / total assets; NII = net interest income / total operating income.

Table 5
Levin, Lin, Chu stationnarity test

Variables	coefficient	t-value	t-star	P > t
LLP	-1.40459	-15.429	-7.87087	0.0000
STDROA	-0.42146	-6.917	-1.89786	0.0289
STDROE	-0.55705	-8.189	3.39656	0.9997
ZROA	-1.03281	-14.676	-8.93678	0.0000
ZROE	-0.84100	-11.071	-4.58022	0.0000
ZPSCR	-0.97628	-14.491	-8.76697	0.0000

Lower p-values imply variable stationnarity

Table 6
Regression results: Sample 1

Dependent Variable: Annual change in Expected Default Frequency	(I) Baseline model		(II) Accounting for stock market effect		(III) Accounting for housing price		(IV) Accounting for market concentration		(V) Alternative model with yield curve slope	
	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error
ΔEDF (t-1)	0.316 ***	0.103	0.214 ***	0.096	0.228 ***	0.096	0.225 ***	0.096	0.325 ***	0.099
Δ3M (t-1)	0.140 ***	0.033	0.075 ***	0.028	0.070 ***	0.029	0.339 ***	0.048		
TGAP (t-1)	-0.184 ***	0.050	-0.065 ***	0.021	-0.062 ***	0.021	-0.221 ***	0.051	-0.125 ***	0.055
ΔGDPN* (t-1)	3.740 ***	0.783	1.525 ***	0.296	1.537 ***	0.295	0.869 ***	0.181		
ΔSM (t-1)			-0.014 ***	0.003	-0.014 ***	0.003	-0.008 ***	0.002		
ΔHP (t-1)					0.001	0.003	0.001	0.001		
HHI							-0.042 ***	0.009		
ΔGDPN (t-1)									0.032 ***	0.010
YSLOPE (t-1)									-0.359 ***	0.069
Sample period	1998-2008		1998-2008		1998-2008		1998-2008		1998-2008	
N. of banks, observations	14	113	14	113	14	113	14	113	14	113
Sargan Test (P-Value)		0.302		0.361		0.162		0.115		0.256
AR1 (P-Value)		0.000		0.000		0.000		0.000		0.000
AR2 (P-Value)		0.539		0.508		0.534		0.646		0.557

Notes: We use Arellano-Bover (1995) system panel-data estimator. "Sargan Test": p- value of the Sargan test for overidentifying restrictions, which is asymptotically distributed as $\chi 2$ under the null of instrument validity. "AR1 (AR2)": p-value of the Arellano-Bond test that average autocovariance in residuals of order 1 (order 2) is 0. Significance levels at 10%, 5%, and 1% are denoted by *, ** and ***, respectively.

Variables definition: ΔEDF = change in expected default frequency (1 year); Δ3M = change in the 3 months interbank rate; TGAP = Taylor rule gap with interest rate smoothing; YSLOPE = slope of the yield curve (10Y-3M); ΔGDPN = change in nominal GDP; ΔGDPN*=ΔGDPN orthogonalized with respect to Δ3m; ΔSM = changes in the stock market return; ΔHP = change in the housing price index; HHI = Herfindahl-Hirschman index.

Table 7
Regression results: Accounting based risk measures (Sample 2)

Dependent Variables: Risk measure	(I) LLP		(II) LLR		(III) STDROE		(IV) STDROA		(V) ZROE°		(VI) ZROA°		(VII) ZPSCR°	
	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error
Risk Measure (t-1)	0.749 ***	0.127	0.695 ***	0.068	0.734 ***	0.057	0.667 ***	0.019	0.324 ***	0.056	0.274 ***	0.054	0.324 ***	0.053
Δ3M (t-1)	0.407	1.379	0.721 *	0.456	-1.082	2.232	-12.476	10.843	-0.167	19.669	26.784 ***	11.227	5.966 *	4.005
Δ3M (t-2)	-1.776	2.282	-0.525	0.952	6.099 *	4.318	23.400	20.313	-4.076	36.197	-62.015 ***	20.175	-16.820 ***	7.476
TGAP (t-1)	-0.296	2.017	-0.746 *	0.478	1.133	2.373	7.837	8.775	-7.995	20.725	-11.000	11.837	-3.126	4.288
TGAP (t-2)	0.639	0.795	0.333	0.263	-2.621 ***	1.313	-8.918 ***	4.230	17.405 *	10.389	18.650 ***	5.753	4.097 **	2.221
ΔGDPN* (t-1)	3.180	3.816	1.556	1.298	-6.673	6.092	-36.142	28.416	28.235	56.571	34.077	32.769	19.359 *	11.766
ΔGDPN* (t-2)	-6.410	4.696	0.849	1.796	13.519 *	8.786	37.120	27.862	-29.244	70.586	-87.907 ***	38.695	-25.243 *	15.061
ΔSM* (t-1)	-0.063	0.097	-0.055	0.039	0.249	0.177	1.140	0.979	0.221	1.526	-2.444 ***	0.860	-0.646 ***	0.312
ΔSM* (t-2)	0.006	0.033	-0.020 **	0.011	-0.065	0.055	0.016	0.145	-0.242	0.445	0.225	0.229	0.073	0.092
Constant	0.687	2.747	0.142	0.781	0.540	3.431	12.926	11.517	59.245 **	29.919	16.990	16.973	5.173	6.346
Sample period	1998-2008		1998-2008		1998-2008		1998-2008		1998-2008		1998-2008		1998-2008	
No of banks, No of obs	37	321	37	297	37	321	37	321	37	321	37	324	37	317
Sargan Test (P-Value)		0.100		0.125		0.338		0.370		0.487		0.711		0.203
AR1		0.000		0.000		0.000		0.096		0.000		0.000		0.000
AR2		0.392		0.730		0.597		0.577		0.737		0.449		0.051

Notes: We use Arellano-Bover (1995) system panel-data estimator. "Sargan Test": p- value of the Sargan test for overidentifying restrictions, which is asymptotically distributed as $\chi 2$ under the null of instrument validity. "AR1 (AR2)": p-value of the Arellano-Bond test that average autocovariance in residuals of order 1 (order 2) is 0. In model IV we used the two step, robust option that we validate with a Hansen test of 0.490. Significance levels at 10%, 5%, and 1% are denoted by *, ** and ***, respectively.

Variables definition: LLP = loan loss provision/total gross loans; LLR=loan loss reserves/total gross loans; STDROA (ROE) = standard deviation of return on average assets (equity); ZROA (ROE) =(100+average ROA)/std dev ROA) is the Z-score of return on average assets (equity); ZPSCR = ZP score computed as: [(average ROA / STDROA)+(average(total equity/total asset) / STDROA)]; Δ3M = change in the 3 months interbank rate; TGAP = Taylor rule gap with interest rate smoothing; ΔGDPN* = change in nominal GDP orthogonalized with respect to Δ3m; ΔSM* = changes in the stock market returns orthogonalized with respect to TGAP. ° for ZROA, ZROE, ZPSCR, signs interpretation is inverted as higher values mean lower bank risk.

Table 8
Regression results: Individual effect linked to bank size (Sample 2)

Dependent Variables: Risk measure	(I) LLP (not applicable)	(II) LLR		(III) STDROE		(IV) STDROA		(V) ZROE°		(VI) ZROA°		(VII) ZPSCR°	
		Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error
Risk Measure (t-1)		0.688 ***	0.034	0.725 ***	0.056	0.656 ***	0.025	0.318 ***	0.056	0.273 ***	0.053	0.315 ***	0.054
Δ3M (t-1)		0.727 *	0.448	-1.713	2.185	-10.521	9.882	-0.843	19.687	26.065 ***	11.189	6.037	4.094
Δ3M (t-2)		-0.482	0.874	5.944	4.270	21.526	24.459	-1.294	36.047	-60.563 ***	20.049	-16.817 ***	7.612
TGAP (t-1)				0.824	2.273	5.611	8.455	-8.184	20.640	-10.153	11.777	-3.166	4.374
TGAP (t-1)*SIZE (small)		-0.96 **	0.495										
TGAP (t-1)*SIZE (average)		-0.75 *	0.484										
TGAP (t-1)*SIZE (large)		-0.64	0.491										
TGAP (t-2)		0.327	0.259										
TGAP (t-2)*SIZE (small)				-2.035 *	1.267	-7.963 *	4.949	11.178	11.595	15.137 ***	6.074	2.499	2.502
TGAP (t-2)*SIZE (average)				-2.103 *	1.267	-6.075	4.428	14.898	10.928	18.612 ***	5.939	4.232 **	2.353
TGAP (t-2)*SIZE (large)				-3.548 ***	1.270	-8.607 ***	4.078	23.378 ***	11.101	20.987 ***	6.106	5.344 ***	2.506
ΔGDPN* (t-1)		1.631	1.260	-6.833	5.969	-36.694 *	24.597	28.965	56.290	29.644	32.459	19.366 *	11.990
ΔGDPN* (t-2)		0.890	1.765	13.809 *	8.691	32.355	32.574	-21.712	70.048	-85.800 ***	38.439	-25.001 *	15.314
ΔSM* (t-1)		-0.054 *	0.036	0.240	0.176	1.043	0.313	0.301	1.526	-2.363 ***	0.855	-0.650 ***	0.319
ΔSM* (t-2)		-0.020 **	0.011	-0.062	0.055	0.035	0.125	-0.256	0.444	0.245	0.228	0.069	0.094
Constant		0.132	0.724	0.292	3.408	12.308	10.498	57.883 **	29.734	17.840	16.902	5.087	6.481
Sample period		1998-2008		1998-2008		1998-2008		1998-2008		1998-2008		1998-2008	
No of banks, No of obs		37	297	37	321	37	321	37	321	37	324	37	317
Sargan Test (P-Value)			0.108		0.300		0.280		0.576		0.641		0.128
AR1			0.000		0.000		0.096		0.000		0.000		0.000
AR2			0.756		0.371		0.598		0.702		0.433		0.052

Notes: We use Arellano-Bover (1995) system panel-data estimator. "Sargan Test": p- value of the Sargan test for overidentifying restrictions, which is asymptotically distributed as $\chi 2$ under the null of instrument validity. "AR1 (AR2)": p-value of the Arellano-Bond test that average autocovariance in residuals of order 1 (order 2) is 0. In model IV we used the two step, robust option that we validate with a Hansen test of 0.491. Significance levels at 10%, 5%, and 1% are denoted by *, ** and ***, respectively.

Variables definition: LLP = loan loss provision/total gross loans; LLR=loan loss reserves/total gross loans; STDROA (ROE) = standard deviation of return on average assets (equity); ZROA (ROE) =(100+average ROA)/std dev ROA) is the Z-score of return on average assets (equity); ZPSCR = ZP score computed as: [(average ROA / STDROA)+(average(total equity/total asset) / STDROA)]; Δ3M = change in the 3 months interbank rate; TGAP = Taylor rule gap with interest rate smoothing; ΔGDPN* = change in nominal GDP orthogonalized with respect to Δ3m; ΔSM* = changes in the stock market returns orthogonalized with respect to TGAP; SIZE = log of total assets (th of euros). ° for ZROA, ZROE, ZPSCR, signs interpretation is inverted as higher values mean lower bank risk.

Table 9
Regression results: Individual effect linked to bank capitalization (Sample 2)

Dependent Variables: Risk measure	(I) LLP (not applicable)	(II) LLR		(III) STDROE		(IV) STDROA		(V) ZROE°		(VI) ZROA°		(VII) ZPSCR°	
		Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error
Risk Measure (t-1)		0.701 ***	0.034	0.748 ***	0.056	0.659 ***	0.022	0.330 ***	0.056	0.279 ***	0.053	0.312 ***	0.054
Δ3M (t-1)		0.687 *	0.445	-2.188	2.171	-9.815	10.426	-0.100	19.687	25.812 ***	11.129	6.681 *	4.077
Δ3M (t-2)		-0.333	0.872	6.182	4.257	19.619	23.706	-2.659	35.884	-60.521 ***	20.004	-18.070 ***	7.608
TGAP (t-1)				1.186	2.246	5.562	9.165	-7.575	20.514	-9.733	11.735	-3.290	4.352
TGAP (t-1)*CAP (small)		-0.51	0.488										
TGAP (t-1)*CAP (average)		-0.91 **	0.481										
TGAP (t-1)*CAP (large)		-0.73 *	0.491										
TGAP (t-2)		0.292	0.258										
TGAP (t-2)*CAP (small)				-4.038 ***	1.303	-6.910	4.725	28.415 ***	11.531	21.176 ***	5.865	5.296 ***	2.562
TGAP (t-2)*CAP (average)				-2.157 *	1.229	-5.993	5.067	12.539	10.792	18.680 ***	5.865	4.750 ***	2.336
TGAP (t-2)*CAP (large)				-2.114 *	1.236	-8.028 *	4.521	12.699	11.364	14.697 ***	5.954	2.109	2.479
ΔGDPN* (t-1)		1.584	1.247	-7.095	5.926	-35.332	24.511	24.101	56.086	28.169	32.546	19.995 *	11.958
ΔGDPN* (t-2)		1.097	1.761	14.085 *	8.645	29.355	33.014	-21.730	69.858	-85.029 ***	38.338	-26.324 *	15.282
ΔSM* (t-1)		-0.048	0.036	0.266 *	0.176	0.974	1.026	0.238	1.515	-2.357 ***	0.852	-0.712 ***	0.318
ΔSM* (t-2)		-0.020 **	0.011	-0.049	0.054	0.035	0.129	-0.279	0.441	0.237	0.852	0.061	0.094
Constant		0.049	0.072	0.696	3.368	12.742	11.222	56.975 **	29.597	17.829	16.837	4.769	6.441
Sample period		1998-2008		1998-2008		1998-2008		1998-2008		1998-2008		1998-2008	
No of banks, No of obs		37	297	37	321	37	321	37	321	37	324	37	317
Sargan Test (P-Value)			0.132		0.424		0.264		0.513		0.433		0.154
AR1			0.000		0.000		0.095		0.000		0.000		0.000
AR2			0.709		0.977		0.565		0.777		0.412		0.050

Notes: We use Arellano-Bover (1995) system panel-data estimator. "Sargan Test": p- value of the Sargan test for overidentifying restrictions, which is asymptotically distributed as $\chi 2$ under the null of instrument validity. "AR1 (AR2)": p-value of the Arellano-Bond test that average autocovariance in residuals of order 1 (order 2) is 0. In model IV we used the two step, robust option that we validate with a Hansen test of 0.412. Significance levels at 10%, 5%, and 1% are denoted by *, ** and ***, respectively.

Variables definition: LLP = loan loss provision/total gross loans; LLR=loan loss reserves/total gross loans; STDROA (ROE) = standard deviation of return on average assets (equity); ZROA (ROE) =(100+average ROA)/std dev ROA) is the Z-score of return on average assets (equity); ZPSCR = ZP score computed as: [(average ROA / STDROA)+(average(total equity/total asset) / STDROA)]; Δ3M = change in the 3 months interbank rate; TGAP = Taylor rule gap with interest rate smoothing; ΔGDPN* = change in nominal GDP orthogonalized with respect to Δ3m; ΔSM* = changes in the stock market returns orthogonalized with respect to TGAP; CAP = total equity / total assets. ° for ZROA, ZROE, ZPSCR, signs interpretation is inverted as higher values mean lower bank risk.

Table 10
Regression results: Individual effect linked to bank liquidity (Sample 2)

Dependent Variables: Risk measure	(I) LLP (not applicable)	(II) LLR		(III) STDROE		(IV) STDROA		(V) ZROE°		(VI) ZROA°		(VII) ZPSCR°	
		Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error
Risk Measure (t-1)		0.070 ***	0.033	0.730 ***	0.056	0.658 ***	0.019	0.316 ***	0.056	0.267 ***	0.053	0.306 ***	0.055
Δ3M (t-1)		0.757 *	0.447	-1.867	2.184	-8.084	13.474	-0.494	19.668	26.447 ***	11.159	5.584	4.079
Δ3M (t-2)		-0.629	0.875	5.891	4.285	20.177	26.199	-2.998	36.125	-60.994 ***	20.023	-16.277 ***	7.601
TGAP (t-1)				1.093	2.269	2.454	10.347	-7.968	20.746	-10.926	11.781	-2.818	4.365
TGAP (t-1)*LIQ (small)		-0.79 *	0.493										
TGAP (t-1)*LIQ (average)		-0.66	0.479										
TGAP (t-1)*LIQ (large)		-0.96 **	0.49										
TGAP (t-2)		0.367	0.260										
TGAP (t-2)*LIQ (small)				-1.689	1.294	-3.032	5.927	12.088	11.755	14.519 ***	6.195	1.767	2.541
TGAP (t-2)*LIQ (average)				-2.715 ***	1.233	-7.531	5.768	18.073 *	10.710	19.027 ***	5.847	4.363 **	2.329
TGAP (t-2)*LIQ (large)				-2.361 **	1.269	-7.485 *	4.518	18.820 *	11.621	20.545 ***	6.102	5.132 ***	2.506
ΔGDPN* (t-1)		1.641	1.251	-7.490	5.994	-29.706	33.034	28.578	56.718	34.326	32.715	18.582 *	12.002
ΔGDPN* (t-2)		0.688	1.764	12.998 *	8.723	36.079	31.885	-25.407	70.418	-85.549 ***	38.386	-24.123 *	15.296
ΔSM* (t-1)		-0.059 *	0.036	0.246	0.177	0.910	1.225	0.255	1.526	-2.410 ***	0.855	-0.618 **	0.318
ΔSM* (t-2)		-0.020 **	0.011	-0.057	0.055	-0.011	0.156	-0.247	1.525	0.240	0.227	0.074	0.094
Constant		0.142	0.719	0.801	3.402	8.307	12.057	59.010 **	29.959	16.764	16.891	5.542	6.461
Sample period		1998-2008		1998-2008		1998-2008		1998-2008		1998-2008		1998-2008	
No of banks, No of obs		37	297	37	321	37	321	37	321	37	324	37	317
Sargan Test (P-Value)			0.096		0.411		0.343		0.507		0.580		0.203
AR1			0.000		0.000		0.090		0.000		0.000		0.000
AR2			0.767		0.699		0.620		0.767		0.431		0.051

Notes: We use Arellano-Bover (1995) system panel-data estimator. "Sargan Test": p- value of the Sargan test for overidentifying restrictions, which is asymptotically distributed as $\chi 2$ under the null of instrument validity. "AR1 (AR2)": p-value of the Arellano-Bond test that average autocovariance in residuals of order 1 (order 2) is 0. In model IV we used the two step, robust option that we validate with a hansen test of 0.418. Significance levels at 10%, 5%, and 1% are denoted by *, ** and ***, respectively.

Variables definition: LLP = loan loss provision/total gross loans; LLR=loan loss reserves/total gross loans; STDROA (ROE) = standard deviation of return on average assets (equity); ZROA (ROE) =(100+average ROA)/std dev ROA) is the Z-score of return on average assets (equity); ZPSCR = ZP score computed as: [(average ROA / STDROA)+(average(total equity/total asset) / STDROA)]; Δ3M = change in the 3 months interbank rate; TGAP = Taylor rule gap with interest rate smoothing; ΔGDPN* = change in nominal GDP orthogonalized with respect to Δ3m; ΔSM* = changes in the stock market returns orthogonalized with respect to TGA; LIQ = liquid assets / deposits and short-term funding. ° for ZROA, ZROE, ZPSCR, signs interpretation is inverted as higher values mean lower bank risk.

Table 11
Regression results: Individual effect linked to income structure, Loans to assets (Sample 2)

Dependent Variables: Risk measure	(I) LLP (not applicable)	(II) LLR		(III) STDROE		(IV) STDROA		(V) ZROE°		(VI) ZROA°		(VII) ZPSCR°	
		Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error
Risk Measure (t-1)		0.698 ***	0.033	0.727 ***	0.056	0.666 ***	0.021	0.317 ***	0.056	0.263 ***	0.053	0.293 ***	0.055
Δ3M (t-1)		0.701 *	0.448	-1.823	2.185	-5.924	11.281	-0.785	19.622	25.413 ***	11.105	6.138 *	4.048
Δ3M (t-2)		-0.465	0.874	6.005	4.288	17.235	23.816	-2.678	36.058	-59.960 ***	19.915	-17.106 ***	7.546
TGAP (t-1)				1.006	2.268	1.210	7.966	-8.057	20.661	-10.278	11.708	-3.304	4.329
TGAP (t-1)*LTA (small)		-0.71	0.491										
TGAP (t-1)*LTA (average)		-0.76 *	0.484										
TGAP (t-1)*LTA (large)		-0.770 *	0.493										
TGAP (t-2)		0.314	0.259										
TGAP (t-2)*LTA (small)				-2.630 ***	1.263	-9.646 ***	4.453	19.704 *	11.426	18.337 ***	5.964	4.731 **	2.439
TGAP (t-2)*LTA (average)				-2.660 ***	1.241	-5.770	4.879	18.764 *	10.755	19.807 ***	5.868	4.984 ***	2.329
TGAP (t-2)*LTA (large)				-1.608	1.284	-3.526	5.162	8.841	11.749	12.781 **	6.188	0.788	2.551
ΔGDPN* (t-1)		1.532	1.257	-7.384	5.978	-24.335	26.602	30.071	56.403	34.704	32.430	20.669 *	11.885
ΔGDPN* (t-2)		0.950	1.762	13.363 *	8.717	35.184	29.685	-25.759	70.258	-84.551 ***	38.172	-25.247 *	15.184
ΔSM* (t-1)		-0.053	0.036	0.247	0.177	0.739	1.071	0.275	1.522	-2.344 ***	0.850	-0.666 **	0.315
ΔSM* (t-2)		-0.020 **	0.011	-0.060	0.055	-0.051	0.121	-0.239	1.522	0.244	0.226	0.067	0.093
Constant		0.114	0.723	0.636	3.398	6.096	9.528	58.908 **	29.840	17.292	16.795	4.945	6.408
Sample period		1998-2008		1998-2008		1998-2008		1998-2008		1998-2008		1998-2008	
No of banks, No of obs		37	297	37	321	37	321	37	321	37	324	37	317
Sargan Test (P-Value)			0.130		0.397		0.343		0.478		0.466		0.186
AR1			0.000		0.000		0.092		0.000		0.000		0.000
AR2			0.720		0.626		0.618		0.757		0.430		0.048

Notes: We use Arellano-Bover (1995) system panel-data estimator. "Sargan Test": p- value of the Sargan test for overidentifying restrictions, which is asymptotically distributed as $\chi 2$ under the null of instrument validity. "AR1 (AR2)": p-value of the Arellano-Bond test that average autocovariance in residuals of order 1 (order 2) is 0. In model IV we used the two step, robust option that we validate with a Hansen test of 0.554. Significance levels at 10%, 5%, and 1% are denoted by *, ** and ***, respectively.

Variables definition: LLP = loan loss provision/total gross loans; LLR=loan loss reserves/total gross loans; STDROA (ROE) = standard deviation of return on average assets (equity); ZROA (ROE) =(100+average ROA)/std dev ROA) is the Z-score of return on average assets (equity); ZPSCR = ZP score computed as: [(average ROA / STDROA)+(average(total equity/total asset) / STDROA)]; Δ3M = change in the 3 months interbank rate; TGAP = Taylor rule gap with interest rate smoothing; ΔGDPN* = change in nominal GDP orthogonalized with respect to Δ3m; ΔSM* = changes in the stock market returns orthogonalized with respect to TGA; LTA = total loans / total assets. ° for ZROA, ZROE, ZPSCR, signs interpretation is inverted as higher values mean lower bank risk.

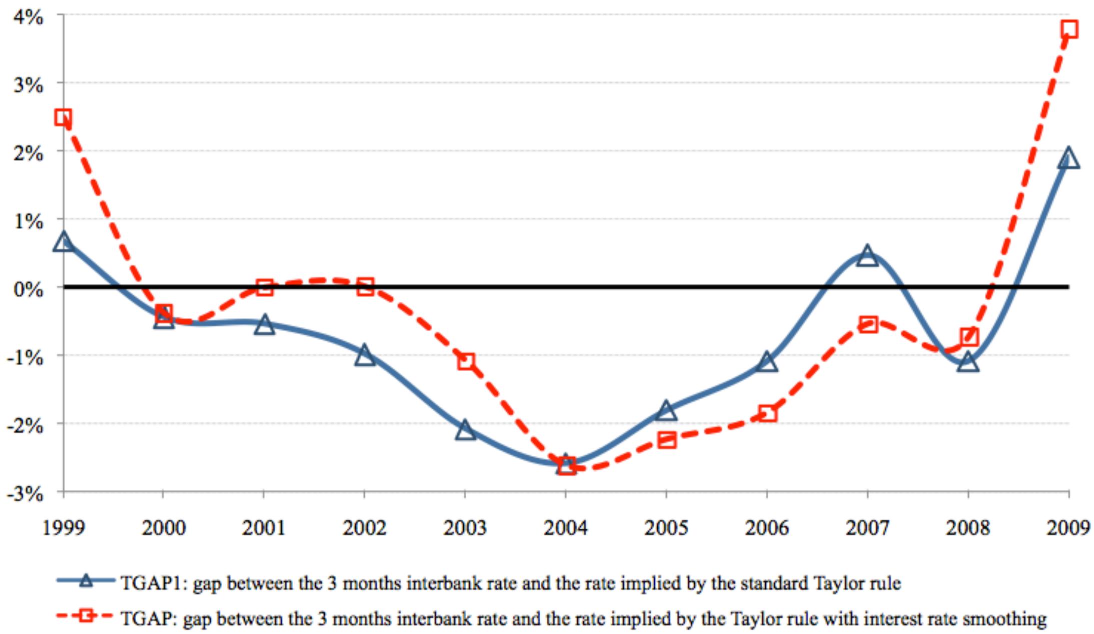
Table 12
Regression results: Individual effect linked to income structure, Net interest revenues (Sample 2)

Dependent Variables: Risk measure	(I) LLP (not applicable)	(II) LLR		(III) STDROE		(IV) STDROA		(V) ZROE°		(VI) ZROA°		(VII) ZPSCR°	
		Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error	Coef.	S. Error
Risk Measure (t-1)		0.708 ***	0.031	0.733 ***	0.056	0.666 ***	0.016	0.324 ***	0.056	0.272 ***	0.054	0.322 ***	0.054
Δ3M (t-1)		0.833 **	0.422	-1.721	2.178	-9.576	9.886	0.284	19.599	26.910 ***	11.219	5.996	4.092
Δ3M (t-2)		-0.599	0.821	6.016	4.306	24.971	21.592	0.628	36.133	-62.556 ***	20.176	-16.955 ***	7.643
TGAP (t-1)				0.839	2.270	2.905	9.491	-10.614	20.704	-10.870	11.837	-3.095	4.383
TGAP (t-1)*NII (small)		-0.51	0.508										
TGAP (t-1)*NII (average)		-3.32 ***	0.644										
TGAP (t-1)*NII (large)		-0.81 **	0.451										
TGAP (t-2)		0.370 *	0.243										
TGAP (t-2)*NII (small)				-3.054 **	1.588	-12.594 ***	5.116	16.088	16.167	21.428 ***	7.852	5.259 *	3.397
TGAP (t-2)*NII (average)				-1.548	2.412	-12.193 ***	4.431	-18.809	26.136	24.809 **	12.315	6.710	5.642
TGAP (t-2)*NII (large)				-2.360 **	1.215	-6.644 *	4.284	16.397 *	10.377	18.608 ***	5.760	4.055 *	2.275
ΔGDPN* (t-1)		2.022 *	1.185	-6.826	5.969	-34.431 *	22.949	32.925	56.415	34.193	32.730	19.424 *	12.023
ΔGDPN* (t-2)		0.529	1.658	13.401 *	8.809	39.362	28.520	-16.771	70.759	-89.531 ***	38.755	-25.743 *	15.420
ΔSM* (t-1)		-0.060 *	0.033	0.243	0.177	1.114	0.935	0.257	1.521	-2.459 ***	0.860	-0.649 **	0.319
ΔSM* (t-2)		-0.020 **	0.010	-0.064	0.177	-0.026	0.136	-0.298	0.445	0.253	0.229	0.075	0.094
Constant		-0.005	0.680	0.400	3.415	8.771	11.070	53.138 *	30.043	17.528	16.994	5.344	6.496
Sample period		1998-2008		1998-2008		1998-2008		1998-2008		1998-2008		1998-2008	
No of banks, No of obs		37	297	37	321	37	321	37	321	37	324	37	317
Sargan Test (P-Value)			0.117		0.406		0.280		0.521		0.706		0.196
AR1			0.000		0.000		0.096		0.000		0.000		0.000
AR2			0.316		0.532		0.623		0.743		0.441		0.055

Notes: We use Arellano-Bover (1995) system panel-data estimator. "Sargan Test": p- value of the Sargan test for overidentifying restrictions, which is asymptotically distributed as $\chi2$ under the null of instrument validity. "AR1 (AR2)": p-value of the Arellano-Bond test that average autocovariance in residuals of order 1 (order 2) is 0. In model IV we used the two step, robust option that we validate with a Hansen test of 0.589. Significance levels at 10%, 5%, and 1% are denoted by *, ** and ***, respectively.

Variables definition: LLP = loan loss provision/total gross loans; LLR=loan loss reserves/total gross loans; STDROA (ROE) = standard deviation of return on average assets (equity); ZROA (ROE) =(100+average ROA)/std dev ROA) is the Z-score of return on average assets (equity); ZPSCR = ZP score computed as: [(average ROA / STDROA)+(average(total equity/total asset) / STDROA)]; Δ3M = change in the 3 months interbank rate; TGAP = Taylor rule gap with interest rate smoothing; ΔGDPN* = change in nominal GDP orthogonalized with respect to Δ3m; ΔSM* = changes in the stock market returns orthogonalized with respect to TGA; NII = net interest income / total operating income ° for ZROA, ZROE, ZPSCR, signs interpretation is inverted as higher values mean lower bank risk.

Chart 1
Monetary policy stance for France



Source: Own calculation
The Taylor rule is computed according to the formula: it=α+βπ (πt - π*)+ βy (yt - yt*) + γ (it - it-1)
TGAP1 follows the standard Taylor rule, with βπ =βy=0.5 and γ=0. The target inflation (π*) has been set to 2% and the real interest rate (α) has been set to 4%. TGAP is computed using βπ =1.5 and βy =0.5. The interest rate smoothing coefficient (γ) has been set to 0.9

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